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Abstract:

For climate scientists, climate change is a problem that has a significant chance of having catastrophic environmental, social and economic consequences during the course of this century. In contrast, public opinion seems to regard with scepticism the pronouncements on climate change that emanate from the scientific community. Why the difference? This is what our research project was designed to examine. Or to put it another way: Assuming that the scientific information is correct, and that without a dramatic change in technology (and policy to promote such a change) there would be a significant risk of man-made, global catastrophe, what must be done to communicate this urgent issue to the public?

We have approached the analysis of this problem by reviewing the literature on communicating climate change. By organising the literature according to the role of the major groups of participants in the information transfer process, useful insights can be gleaned. These groups include scientists, business, the government, the media and the general public. This analysis leads to an overall model of the information transfer process that highlights various issues including the role that the media plays as a lens through which the public observes scientific results.

Communicating Climate Change: A Literature Review

(Paper to the 55th Australian Agricultural and Resource Economics Conference, Melbourne, February 2011)

Kevin A Parton and Mark Morrison

Abstract

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Introduction

The vast majority of climate scientists are in agreement that climate change is a global problem that has a significant chance of having catastrophic environmental, social and economic consequences during the course of this century. This is caused by dependence in advanced nations on the carbon economy, and global warming is a result of anthropomorphic emissions of greenhouse gases into the atmosphere (Oreskes 2004).

In contrast, public opinion seems to regard with scepticism the pronouncements on climate change that emanate from the scientific community. Why the difference? This is what our research project is designed to examine. Or to put it another way: Assuming that the scientific information is correct, and that without a dramatic change in technology (and policy to promote such a change) there would be a significant risk of man-made, global catastrophe, what must be done to communicate this urgent issue to the public?

Two ways to look at the impact of transmission of information from scientist to the public are:

(a) Assess public opinion before and after major announcements, for example the Stern Report or the Rudd Government's Green paper, and see what effect the announcement has had, and

(b) Examine in detail the role of the major groups of participants in the information transfer process.

In our preliminary work we have reviewed some type (a) analysis. Some results were as expected, for example (Zia and Todd 2010):

- If your ideology is conservative then you are less likely to believe in climate change and hence be largely impervious to these major pronouncements;

- Education is directly related to a belief in climate change, with people who have a tertiary education more likely to believe in climate change than those who don't.

On the other hand some results were unexpected. For instance, after major announcements supporting action to mitigate climate change public scepticism increased. There seemed to be several reasons for this, but an important reason is related to a poor understanding of science particularly related to the accumulation of errors.

A study of the transmission of economics information by one of the authors (Hatfield-Dodds and Morrison 2010) reveals also the need to be precise in the provision of information and avoid reference point bias when simplifying the message. They examine the incorrect believe that reducing emissions would result in incomes falling from current levels, rather than rising more slowly. Correcting this bias by providing information on both policy impacts and changes in income relative to today results in "one in three US respondents who do not support action when presented as apparent loss would support action when presented as a forgone gain, and almost one in two Australian respondents" (Hatfield-Dodds and Morrison 2010, p. 13).

For the type (b) analysis, where you analyse the role of major groups, focus can be placed on five broad groups - scientists, business, government, the media, and the public.

Scientists: When scientific information is released, it passes through a media filter before it reaches the public. The original authors may publish their results in a peer reviewed scientific journal. Usually the flow of information to the media will commence after this. This information will consist of media releases by the institution in which the research was conducted together with comments by other scientists, scientific institutions and (increasingly) business organisations that have a commercial interest in the results.

Business: Without developing any sort of conspiracy theory, it is clear that the commercial interests of some business organisations will be affected by the introduction of a price on carbon. In our free-enterprise economy, these businesses are obliged to protect their stakeholders and de-emphasise any result that suggests that climate change is accelerating and to doubly emphasise any result that implies the opposite. Of course, some forward-thinking businesses which will be affected by a carbon price have already seized their opportunities by beginning to invest in new more sustainable technology.

Government: With the 2008 Green Paper, the Rudd government seemed to be taking the lead on climate change policy. However it seems that government is now more subservient to public opinion and will simply try to avoid controversial issues.

Which brings us to the media: Some members of the media like to think of themselves as neutral transmitters of information that the public needs to have. Others acknowledge that they are an important force in forging public opinion. Indeed, some seem to view themselves as the last remaining protectors of the public interest.

Media as business: A business view of the media would have the profit motive as central, and suggest that there is profit in promoting controversy. Whatever is the case in a particular instance, the members of the media together are a filter through which information is amplified, distorted, muted, or half-truthed before reaching the public.

In this situation it is important that those in the media who report climate change issues are well-educated in science. As an example, the media needs to be able to judge the level of importance of errors in science. If 1% of scientific information contains an error, then in 100 pieces of information there will be one error. But at time proceeds, we have not 100 pieces of information, but 10,000. So at the same 1% error rate there are 100 errors to examine. This can be a challenge for the media, because each one of these errors could be insignificant to scientists, but contain a gold mine of controversy for journalists.

So an added difficulty for science is that, as the amount of information produced increases, so do the errors. While proportionately there are few errors in the information provided, because more work is being done, there are, in absolute terms, more errors and that is what the media have tended to focus on.

The public: So various signals reach the media, where journalists and reporters mould the message into something that will interest their customers. The customers themselves, as consumers of information, can be highly selective in terms of what components of the media they interact with (conscious choice), how they allow the information to influence them (consciously) and have attitudes that (partly sub-consciously) affect influence.

Given this backdrop, the remainder of this paper reviews key components of the literature on communicating climate change. First we examine framing and the position of government in relation to the climate change message in terms of group discourses. Next the climate-change literature related to science, business, the media and the public is considered in sequence. There then follows a section where we attempt to integrate the key issues in a model of the information network. Finally some conclusions are drawn.

Framing

How the question of climate change is framed is critically important to the way in which it is perceived by the public and policy makers, and hence framing is a significant driver of public policy. A frame is a lens through which we see the climate change issues. At its most fundamental level a frame is a type of discourse or a way of describing a phenomenon (Ingstad and Whyte 1995). As such it is based on a constructivist epistemology (Fletcher 2009), that describes climate change in terms of an illuminating summary of the situation

containing a few key relationships that groups of individuals in society hold as subjective truths. Hence a frame is a fairly enduring way in which climate change is perceived. The media often create or develop frames, but they can equally be used by politicians, scientists, business organisations or indeed anyone wishing to give particular emphasis to the issues.

As an example of framing, Fletcher (2009) shows how climate change in the US between 2001 and 2008 has been viewed through three successive frames. The first was 'scientific scepticism'. This was promoted by the US government and some businesses with interests in the carbon economy. The theme of this frame was that science is uncertain about the extent of climate change and so we have no basis for anything other than a tentative public policy. During this early period, Luntz (2002) convinced the US government to adopt the term "climate change" instead of "global warming".

Only limited policy change occurred and the "arid and circular debate between sceptics and believers bogged-down US climate discussions at both the domestic and international levels" (Fletcher 2009, p.806).

According to Fletcher (2009) there then followed a second frame for climate change, 'the security threat'. This developed against the backdrop of hurricane Katrina (in 2005). This positioning of climate change in a security frame brought US defence and intelligence into the picture and enabled co-operation between the major political parties on climate change legislation.

The final frame in Fletcher's (2009) analysis is 'climate change as an economic opportunity'. This has been promoted by the Apollo Alliance (2008) as a means by which the new green economy can offer prosperity to all by the "development and deployment of clean energy sources such as wind and solar, and the integration of energy, security, climate stability and economic prosperity" (Fletcher 2009, p. 810).

At different times, all of these frames were supported by the US government. However a frame can be a perspective of the community independently of government, of a section of the community, of a business or group of businesses, the media, or a non-government organisation.

Many would regard the frame that involves limiting CO_2 emissions at 350 ppm or 450 ppm and global temperature increase to 2^oC as the most pervasive frame to date. In Australia this frame has become central in domestic (Commonwealth of Australia 2008) and international policy discussions (Whalley and Walsh 2009).

A problem with this frame which is analysed by Boykoff (2010, p.57) is that "even the traditional IPCC range [of emissions] is inconveniently large when trying to formulate a policy that does not overshoot a 2^oC temperature target". Moreover, stabilisation is difficult "given (1) the scientific community's lack of progress on narrowing the possible range of climate sensitivity and (2) the timescale mismatch between equilibrium concentration and temperature targets and short-to-medium-term policy formulation."

Boykoff (2010) concludes that it would be better to have a stabilisation-of-CO_2e frame rather than a stabilisation-of-temperature frame, because at least this considerably reduces the uncertainty in point (1). However, we would still be left with the issue of politicians in the western democracies elected for periods of up to five years dealing with policies that have CO_2e targets decades ahead.

Even worse than this is the natural progression from framing based on climate/CO_2e stabilisation to apocalyptic framing. According to Foust and Murphy (2009), there are two forms of this: tragic and comic. With tragic apocalypse the consequences of climate change are emphasised as a global catastrophe that humans cannot alter. The consequences, to name a few include melting of the West Antarctic Ice Sheet, the disappearance of Arctic sea ice, disruption of the Gulf Stream, extinction of polar bears, and loss of large sections of low-lying countries like Bangladesh. Tragic discourse tends to emphasise the high likelihood of such events and suggests an unstoppable, non-human force behind them.

Two important consequences of the tragic apocalyptic frames are that it discourages action and invites climate change sceptics to claim that scientists are alarmist (Foust and Murphy 2009, p. 162).

The comic version of the apocalyptic frame considers the situation to be a crisis rather than a catastrophe. It forecasts a business-as-usual future that challenges the existence of humankind, but still permits mitigating and adaptive action. Indeed by comparison it is often

an optimistic view of climate change in which once humans realise the crisis they will take it seriously and respond by acting collaboratively in the areas of energy consumption, water use, transportation, agriculture, etc. The cycle from crisis to salvation is in a sense the working out of the climate-change-as-an-economic-opportunity frame.

The concept of tipping points has become a significant feature of science discussion about climate change (Russill 2008; 2011). While tipping points are often expressed in comic apocalyptical terms by scientists (i.e. there are important thresholds that can be avoided if use changes our behaviour), Antilla (2008) shows that the treatment of tipping points by the media in both the UK and the US is largely superficial. Indeed, "organisation of climate stories that pass over the concept of feedback loops, when it is a major component of the research being covered, is a framing issue" (Antilla 2008, p.251).

In a pioneering study of framing sequences, Weingart *et al*. (2000, p. 280) concluded that "in the German discourse on climate change, scientists politicised the issue, politicians reduced the scientific complexities and uncertainties to CO_2 emissions reduction targets, and the media ignored the uncertainties and transformed them into a sequence of events leading to catastrophe and requiring immediate action." This combination of frames produced an outcome overall which was akin to a comic apocalyptic frame. (Gavin (2009) argues that it was the German political system, particularly proportional representation and newspaper readership, that produced these reinforcing components.)

Framing is clearly important to the climate change message, and polling during 2009 in the US suggests that something is amiss in the form of framing adopted. The level of concern by the US public about climate change has reduced and the proportion of citizens who think the average temperature on earth has been increasing has "dropped to 57% from 71% in April 2008", and the proportion "who believe that the seriousness of global warming is exaggerated hit 41%, a record high in the 12 years Gallup has asked that question" (Kerr 2009, p. 928). Though there is little empirical evidence, we suspect that there has been a similar trend in Australia.

Scientists
In a short essay and a longer review article (Oreskes 2004a; 2004b) the scientific consensus on climate change is presented. While more results have been obtained since 2004, the

essential scientific position is unchanged, and in the following paragraphs we present a summary of Oreskes' argument.

Policy makers have used the argument that the science is uncertain to avoid adapting strong measures to reduce greenhouse gas emissions (a scientific-scepticism frame). This stance has been supported by some businesses, and overall an impression has been created that there is disagreement in the scientific community. Oreskes (2004a) presents evidence to show that this is not the case. She quotes various IPCC reports (eg McCarthy *et al*. 2001), a National Academy of Science (2001) report, the American Meteorological Society (2003), the American Geological Union (2003), and the American Association for the Advancement of Science (2002). All these conclude that climate change has been taking place and that the evidence of human modification of the climate is compelling.

Oreskes (2004b) examines the evidence in the scientific literature by reviewing the abstracts of 928 articles, discovered following a search using "global climate change". None of these articles "refutes the statement: "Global climate change is occurring, and human activities are at least part of the reason why"." (Oreskes 2004b, p. 71).

Oreskes (2004b) makes the following points: (a) while there is consensus about the existence of climate change, there is reasonable disagreement about what to do about it, and people confuse these two issues; (b) there are uncertainties in projections about the future climate and these are easily conflated with uncertainties about the current situation; (c) scientists have not managed to explain themselves to the public; (d) most scientists are interested in the production of knowledge rather than its dissemination; and (e) many scientists feel uncomfortable in the public arena because they could be accused of compromising their objectivity.

The following is a summary of the scientific consensus position on climate change. First, there has been an increase of $0.7^{\circ}C$ to $0.8^{\circ}C$ in global temperatures in the last 150 years since temperatures have been recorded. Second, this has been accompanied by an increase in greenhouse gases in the atmosphere, from about 310 ppm to 390 ppm CO_2e over the last 50 years. This increase is associated with the expansion of industrial activity. Third, there is a well-known, and well-accepted direct relationship between an increase in CO_2 and an increase in temperature. Fourth, while all climate change modelling predicts future increases

in temperature, the extent of the increase and rate of change are uncertain. This is because there are parts of the science that are incomplete and that may involve feedback effects of the increasing temperature and CO_2. These effects could be positive (reinforcing) or negative (dampening). Fifth, given the uncertainty about the likely extent and rate of change, politicians feel uncertain about what to do in the policy arena.

Sixth, we can nevertheless point to many examples where policy is constructed in the face of uncertainty. The setting of macroeconomic policy is a prime example. Even in our personal lives, most people take out car insurance despite having only the vaguest idea of the risks involved.

In the context of insurance, we can think of a dichotomous future either with or without damaging climate change, and we can either introduce or not introduce policies that mitigate against and adapt to climate change. This results in four possible futures, three of which are relatively good and one which is bad. The three good futures are: that we act to introduce policy and there is underlying damaging climate change, but we avoid the main damage because of the policy; we act but the underlying climate change is not damaging, and we end up with a more sustainable technology; and we do not act and there is no damaging climate change. The bad future is where we do not introduce policy and there is damaging climate change.

Seventh, we can observe that both governments and individuals have commenced a kind of low-cost hedging behaviour. Governments in Australia, Europe and North America have provided incentives for (a) individual households to purchase solar panels and solar hot water systems and (b) industry to experiment with new technology such as "clean" coal technology. Moreover, with no government incentives some individuals are dabbling with more sustainable lifestyles (more on this below).

In the scientific dissemination process that interacts with policy makers we can think of three alternative models (Habermas 1971; Goode 2005). Rather like the standard positive economics approach, the decisionist model has scientists using a traditional approach that has them presenting results to policy makes in a detached manner. The policy making process, regulated by democratic institutions, then uses the results to inform policy choice. This model is democratic, but could result in irrational policy outcomes.

At the other extreme, under the technocratic model, scientists are fully engaged in the policy making process and drive the underlying goals. This model is less democratic, but should avoid some of the irrational outcomes of the decisionist model.

With the third model, the pragmatic model, positioned in the middle ground between the other two, there is consultation and mediation between scientists, policy makers and the public. This should lead to reasonably democratic and rational outcomes.

While each model has a tendency to become prominent under particular circumstances, there has been a fundamental shift in modern communication systems, including the Internet, that has made the dissemination of information more rapid and, importantly, more democratic. This has impacted on the three models. Minority groups can much more easily represent their position. However, at the same time, the quality of communications is degrading (Goode 2005). The media cannot just present news as a description of the facts, it must be embellished as entertainment.

In an ironic twist, science is both the basis of the technological revolution that is facilitating these changes in communication and a victim of the changes. The scientific message about climate change is deep and complex while the medium of communication is becoming superficial and simple. Scientists have become more engaged in the dissemination process and, while they may follow a decisionist model in their official lines of communication, there has also been a strong pragmatic shift by science. In a sense this represents science (as one of the minority groups) staking its claim in the new, more democratic communication system, in order to protect society from irrational outcomes that might occur under a decisionist model, impacted as it now is by many outside influences that science might view as stochastic interference.

The increased participation by scientists in the public debate has led to another irony. In order to provide balance in what is seen as a scientific controversy, the media have given the resulting impression that there is a similar level of scientific support for the consensus and the climate-change sceptics (Rogers 1999).

Business

With respect to climate change, researchers have shown that different businesses have pursued "defensive strategies" that dispute the scientific consensus right through to "proactive strategies" such as support for regulation. The literature tends to concentrate on three aspects: the rhetoric (often in company documents such as annual reports), the actions (ranging from simple promotion of energy efficiency to redesign of production processes), and the underlying philosophy (a radical change in the way of doing business in response to the climate-change challenge) (Ihlen 2009).

Ihlen (2009) analyses the non-financial reports of the world's 30 largest corporations. He finds that while their rhetoric has generally become more accepting of the consensus view of climate change, there is extreme variation in the attention they pay in such documents to climate change issues. Although some studies have pointed to location of home base (as a determinant of how much attention a company gives to climate change) (Skjaerseth 2005), and others highlight the industry in which they operate as being important (Jose and Lee 2007), Ihlen (2009) finds that these influences are relatively unimportant. Only in the case of the three major Chinese corporations, that mention climate-change issues infrequently, does home base have any influence.

With respect to actions, the 30 corporations in Ihlen's (2009) sample have focused on improving energy efficiency and reducing waste. It could be argued that these are relatively easy measures that should offer both financial gains and reduced carbon footprints for the companies concerned. For example, "General Electric has set a goal of reducing its GHG emissions by 1% by 2012" (Ihlen 2009, p.255).

Of the firms considered, perhaps HSBC is moving further than the others: "HSBC states that the corporation has been carbon neutral since 2005, as it offsets its emissions by paying for measures elsewhere" (Ilhen 2009, p.255). Also HSBC tends to view the situation using an economic-opportunity frame by advising its clients how to capitalise on growth in areas such as clean energy generation (Ihlen 2009, p.256). These are again probably easy measures for HSBC.

Ihlen's (2009, p.244) conclusion is that "there is little to suggest, however, that corporations engage in the radical rethinking of systemic problems that the situation's gravity would seem to call for."

This leads to a second business issue, viz. an examination of the factors that influence the effectiveness of advertising related to environmental issues. Such advertising can be used by firms or public sector organisations to alert consumers or the public either to purchase a particular product or service that has a reduced carbon footprint or to change their behaviour in an emission reducing manner.

In general there are four types of claim that can be made in such advertising: product-related claims, process related claims, image-related claims, and information about the environment (Carlson *et al*. 1993). The first two of these are substantive claims in relation to the advertised product or service; the second two are associative claims related to an image that the advertiser wants to establish in the minds of customers and are not directly linked to a product or service. Carlson *et al*. (1996) made a comparison between Australia, Britain, Canada and the United States and discovered significant differences between these four countries across these four types of claim. In Australia almost 60% of the environmental advertising was substantive (product or process related) while in the US less than 30% was. "US organisations may be creating the illusion of being "green" when, in fact, they are not making significant contributions and improvements to the physical environment in terms of their products and production processes" (Carlson *et al*. 1996, p. 65).

Polansky *et al*. (1998) take this issue further by examining whether environmental advertising by firms is misleading. Davis (1994) shows how difficult it is for firms to alter their environmental image in the eyes of consumers; perhaps few would pay much credence to the Exxon Mobil (2006) claim that it is developing strategies to address the climate change risk.

The Polansky *et al*. (1998) experiment involved judges examining the environmental information presented on bottles of dishwashing liquid. The six judges had to first determine what environmental information was presented and second assess whether it was accurate. Across the 20 brands investigated, 96 individual pieces of environmental information were identified by the six judges, but only 24 of them by all six. Of the identified items, 36% were "acceptable" and the other 64% were "poor explanation", "no explanation" or "meaningless". Hence overall, Polarskey *et al.* (1998) concluded that the majority of marketing claims about the environment in their study are misleading.

The Media

In our exploration of the differences between the scientific consensus on climate change and general views on the issue, much could be said about the role of the media. We have reviewed this part of the literature through two components: qualitative analyses of the role of the media in information transfer, and more quantitative assessments of the influence of the media on public opinion.

The first issue that stands out clearly in the literature is that there is substantial difference between what the media have presented as climate change and what the scientific consensus says that it is (Boykoff 2007; 2008). In both the US and the UK on television and in newspapers there has been an attempt to achieve 'balanced reporting', and 'contention'. This has meant an over-representation of sceptical viewpoints relative to the number of scientists that hold such views. However during the 2000s the media have tended to move towards the view that climate change has an anthropomorphic basis, particularly in the UK (Boykoff 2007).

Despite such eventual changes towards the scientific consensus position (Antilla 2010), it is clear that there are characteristics of the media that put them in opposition to science. While science attempts to discover agreement on issues, journalism naturally puts conflicting views (Smith 2005).

To compound the problem for the media there is the issue of stories on climate change having to compete for attention with other newer, seemingly more concrete, less complex issues (Gavin 2009). Pietsch and McAllister (2010) show how rapidly environmental issues can move on and off the media's agenda.

In examining broadcast journalism, Marr (2004) claims that journalists succeed in maintaining a balance between education and entertainment. In contrast, Lloyd (2004) puts the counter argument, claiming that there is a blurred distinction between news and comment. An optimistic slant on this issue is provided by a series of experiments conducted by Hwang and Southwell (2009). They showed that there was a dramatic improvement in the understanding of science by members of the public who were exposed to improved science television programming.

The Public

Various articles view the public as passive receivers of climate change signals. Others analyse sections of the public as actively engaged in seeking out climate change information as they pursue sustainable lifestyles.

Modelling the Information Network
The above analysis suggests the concept of a model of the information network. This is developed in Figure 1, which contains all the main actors of our previous discussion together with actions and events that link them. Starting with climate change as a societal problem, there are indicators of the extent of the problem that reach policy makers. In addition there are focussing events (Birkland 1998), like Hurricane Katrina.

Policy makers are influenced by these indicators and focussing events and their policy analysts, the political mood, feedback from existing policy and suggested solutions by experts. The apparent demise of the Emissions Trading Scheme in Australia can be analysed in terms of these influences. Also by considering these wider influences, it becomes clear why apparently important science messages get swamped in policy deliberation by other considerations.

Science experts are the other important group in the inner policy circle. They complete analyses of the climate change problem and suggest possible solutions.

Outside the inner policy circle, the media and the public interact to generate the political mood. The network is completed by information flows from the inner policy circle, largely through the media to the public, and back from the political mood to policy makers. Pralle (2009) refers to this type of a network as a "policy stream". While much more research is warranted on communication of climate change, she recommends various actions by advocacy groups. A selection of these is relevant to communication of climate change on its scientific merits.

With respect to indicators, scientists need to report regularly on a few key climate change variables, emphasise the scientific consensus, outline any specific local impacts (for example,

in Australia, flooding as a result of increased climate variability may be more influential than melting glaciers), and report on any human health impacts (for example, the distribution of vector borne diseases, heatwaves and air pollution).

With respect to solutions, scientists need to describe existing solutions such as energy efficiency gains following consumers' behavioural change to simultaneously reduce both their own financial costs and their carbon footprint. Extending this further it would be useful to obtain projections of energy supply and price and estimate the points at which new, non-polluting technology would be competitive. Furthermore, there should be proper costing of the alternatives, including the cost of doing nothing (Stern 2007).

Conclusions

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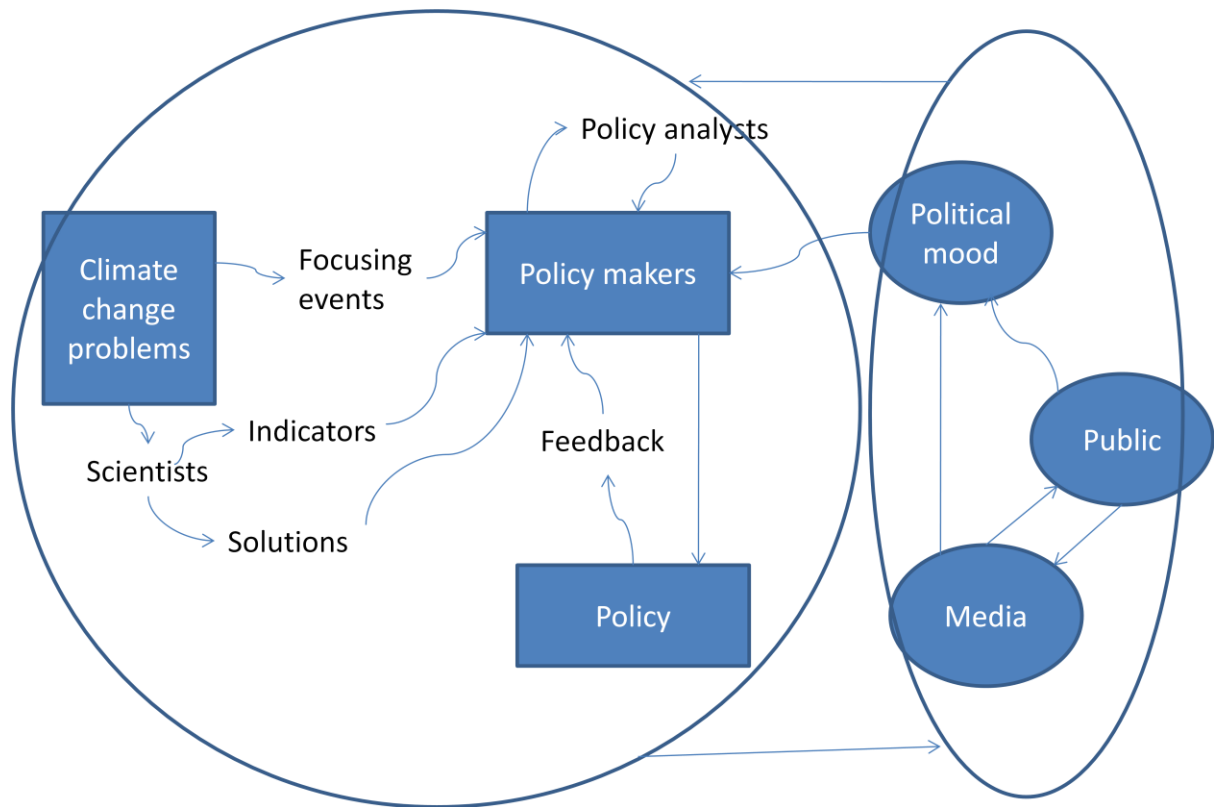
Figure 1: The Policy Stream for Climate Change Policy